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This workshop designed an integrated investigation of the stratigraphic signature that is created on the shelf and slope portions of continental margins. The goals of the overall program will:

add geological perspective to shelf and slope studies of sediment transport, morphology and fine-scale stratigraphy (time scales $<10^2$y);

provide physical constraints on interpretation of high-frequency seismic stratigraphy in the upper ~100m of the seabed (time scales $\sim10^4$-10^6y);

develop approaches for interpolating between these time scales and obtaining stratigraphic insights.

In order to reach these goals, field work will investigate the margins off northern California and New Jersey. Interdisciplinary studies will have a geologic focus designed to unravel the complex relationships between formative sedimentary processes and preserved strata. In the two diverse study areas, where much reconnaissance work already has been completed, a holistic approach to shelf and slope environments will observe and model sediment transport and accumulation and their relationships to resultant stratigraphy.

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SHELF SEDIMENT DYNAMICS AND DEVELOPMENT OF LITHOSTRATIGRAPHY

OBJECTIVES

Sedimentary strata on continental shelves are produced by a hierarchy of processes that are coupled in complex ways. These processes include physical forcing mechanisms and associated sediment dispersal in the water column as well as interactions with the seabed. The resultant fine-scale sedimentary strata are subjected to post-depositional modification (i.e., physical and biological reworking). The processes are repeated through time to create sequences that constitute the sedimentary record. ***The goal of this project is to relate the operative processes to the resultant stratigraphy in an energetic depositional shelf setting.*** Within this general framework, four specific objectives have been identified.

The first objective is ***to understand the water-column processes that lead to a divergence of sediment flux.*** This objective distinguishes the project from previous observational studies of shelf sediment transport that have resolved the vertical distribution of sediment concentration and velocity at specific locations and have documented differences between cross-shelf sites, but have not resolved the divergences that lead to erosion or deposition of sediment, nor identified the processes that produce divergences (see Fig. A1).

The second objective is ***to examine the short-term (hours to weeks) physical and biological processes operating within the upper sea floor that modify bed properties, and that produce event beds.*** Previous studies have not combined high-quality fluid-dynamical measurements with simultaneous characterization of the seafloor during an event, and hence have not been sufficient to identify and quantify the links between the two.

The third objective is ***to quantify the biological and physical processes responsible for post-depositional modification of strata over a wide range of time and space scales.*** This component of the project involves direct observations of strata evolution, with the

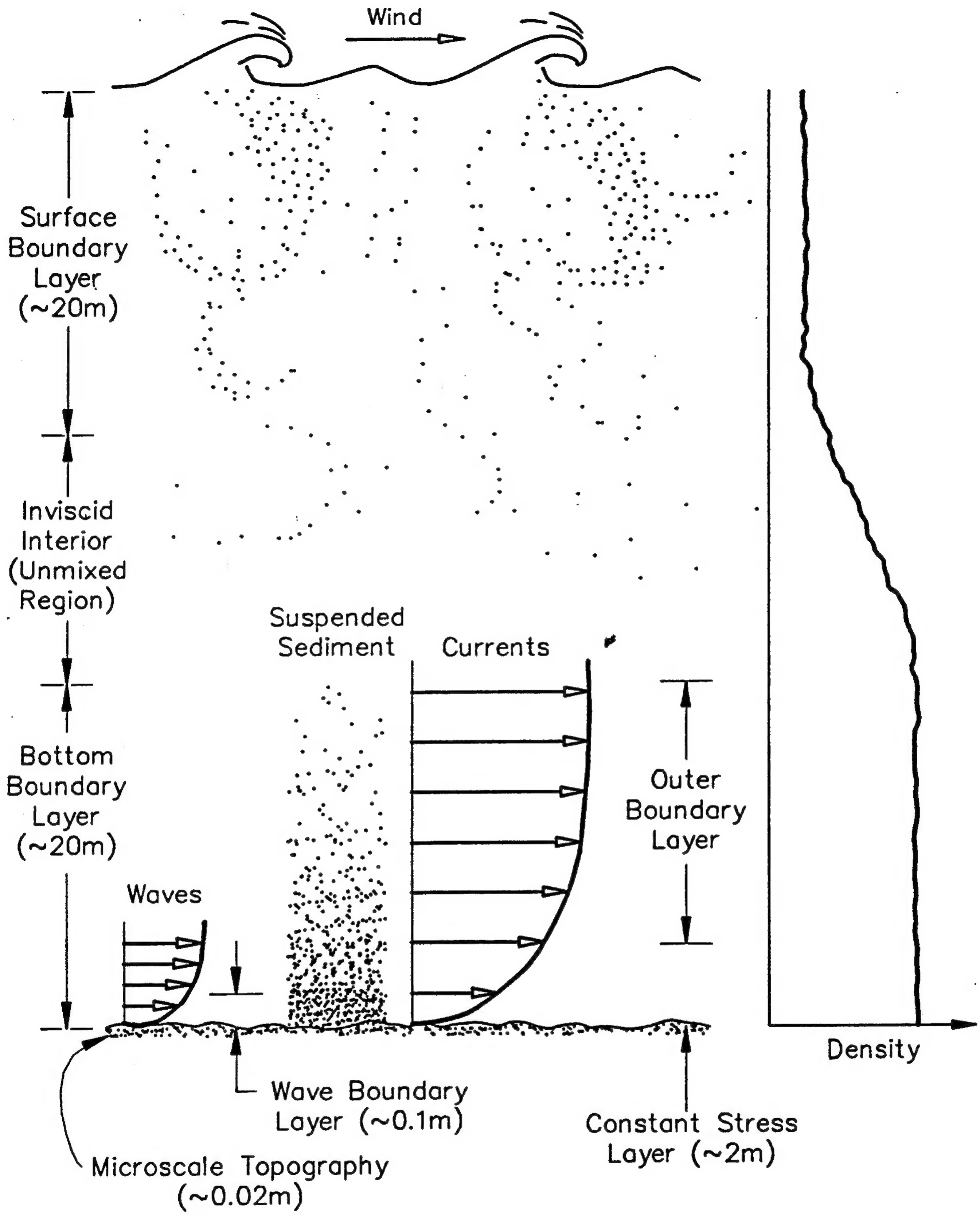

Figure A1. - Schematic drawing of physical processes operating within a shelf boundary layer to transport sediment and form strata.

accompanying physical, biological and geological measurements required for their interpretation.

The fourth objective is ***to explore the long-term (10^2-10^6 y) development of stratigraphy by the processes identified in the three preceding objectives.*** This will provide geological relevance to the project (Fig. A2), and will tie it to other projects in STRATAFORM.

RELATIONSHIP TO PROGRAM OBJECTIVES AND OTHER PROJECTS

The proposed research will address the formation of shelf strata on time scales from seconds to millennia, with a focus on the shorter end of this spectrum. The research will provide input for understanding stratigraphic bounding surfaces and for interpreting the strata preserved between bounding surfaces. The investigation will evaluate the processes creating strata on fundamental time scales of fluid-dynamical variability (seconds to months) and will follow the preservation of these strata through time scales of decades to millennia by progressively expanding scales of observation (e.g., collection of longer cores, measurement of radioisotopes with longer half-lives).

Probably the most valuable contribution to the associated studies of the continental slope will be insights regarding transfer of sediment across the shelf break. This will include knowledge of the mechanisms for particle transport as well as estimates for the mass of sediment moving between the two areas. An interesting possibility is to extend observations of fine-scale strata formation from the shelf to the upper slope, in order to contrast the mechanisms operating in these two fundamentally different environments.

Physical insights regarding strata formation will improve interpretations of geological records observed through seismic profiling. Sediment cores collected for documentation of strata formation also will be used to provide ground truth (i.e., measurements of physical and acoustical properties) for high-frequency seismic studies (kHz range).

A-1

Synthetic storm bed sequence

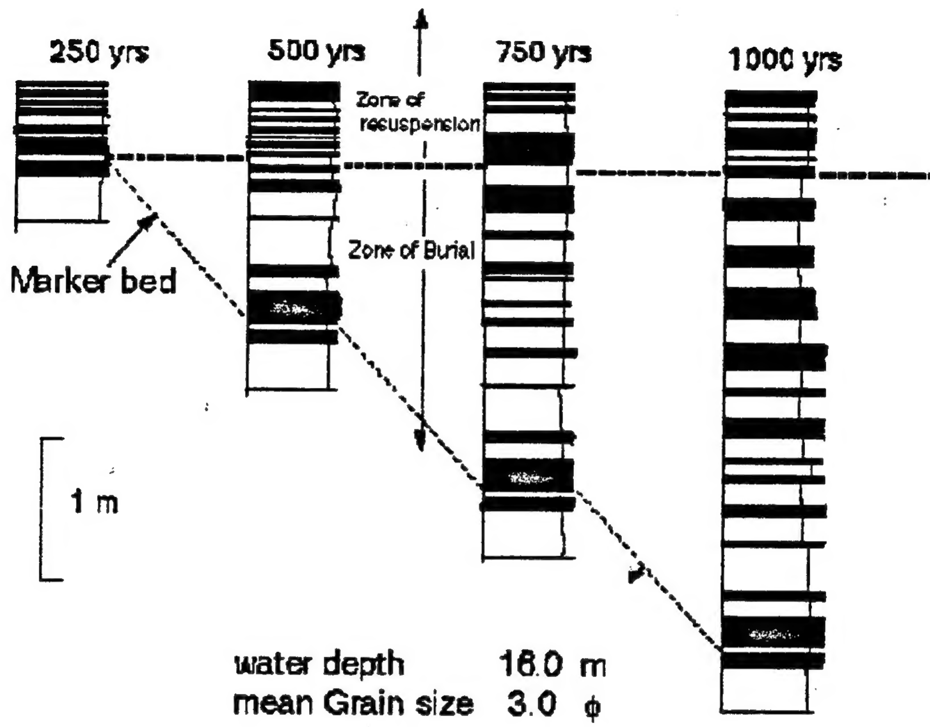

Figure A2. - Synthetic storm-bed sequence evolving over 1,000 years in 250-y time steps. Note ephemeral stratigraphy in the zone of resuspension. Beds of short recurrence periods (< 5y) are eventually destroyed during the formation of beds with longer recurrence periods (from Niedoroda et al., 1989).

APPROACH AND TECHNOLOGY

The approach is designed around a shelf deposit with substantial riverine influence that is characterized by a transition from inner-shelf sand to mid-shelf silt (Fig. A3). The initial phase of the project will focus on processes occurring near the lithologic boundary. This is where the steepest gradients in sediment flux and the largest range of event beds in the smallest window of time and space are expected to occur. Observations gathered in this area will shed light on basic strata-forming processes, which will aid in the understanding of fluvial dispersal systems, sedimentary-facies distributions, and transgressive systems tracts on continental shelves. Processes on the outer shelf, including sediment bypassing and fluxes to the upper slope, are additional interests. The project consists of four components, each of which addresses one of the objectives.

Sediment Transport

The objective of the sediment transport component is to identify, understand and quantify the physical processes (Fig. A1) producing divergences and convergences of sediment flux near regional-scale mud-sand transitions on energetic shelves. The focus is on divergence (and convergence) because this quantity produces erosion and deposition, which in turn lead to formation of event beds, and because previous programs have addressed the flux itself in a comprehensive manner. The emphasis on regional-scale mud-sand transitions is consistent with the overall approach of the project and leads to well defined scientific questions.

A primary focus will be on fluid-dynamical processes within the bottom boundary layer that cause and maintain regional-scale mud-sand transitions. For example, in some environments these transitions occur near breaks in bottom slope, which in simpler cases are not accompanied by frontal structures in the water column. Recent observational and theoretical work indicates that bottom slope, in combination with planetary rotation and

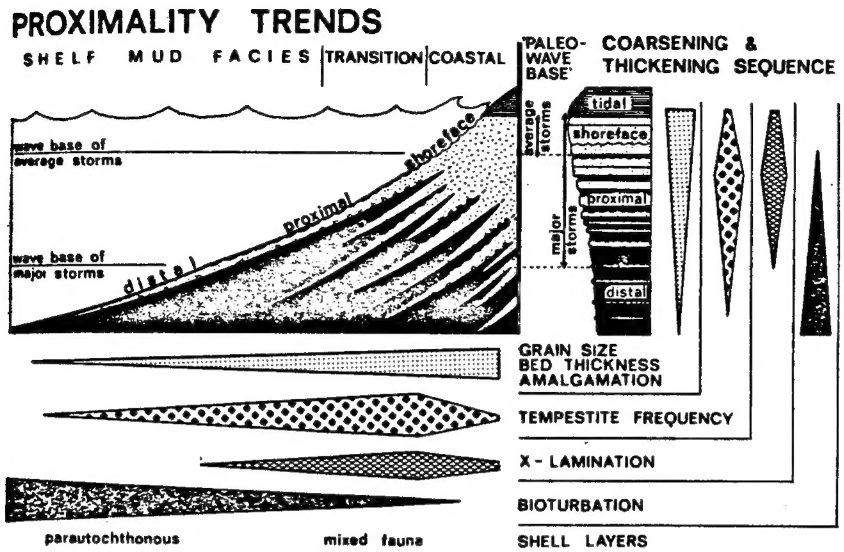

Figure A3. - A schematic example of interbedding between sand and mud layers in the North Sea. Distinct transitions of layer character occur both vertically and horizontally as the shelf accretes and progrades (Aigmer and Reineck, 1982).

density stratification, has an important effect on boundary-layer structure and in particular on across-isobath Ekman transport. These results suggest that a break in bottom slope produces a divergence of Ekman transport that could maintain a transition in bottom sediment texture. This idea will be examined by means of simulations based on mathematical models, which then will lead to detailed design of an observational program.

Insights gained from studying processes that maintain regional-scale mud-sand transitions will lead to a better understanding of the interstratified mud and sand layers that characterize transitions on small spatial scales (Fig. A3). It may be, for example, that offshore Ekman transport leads to formation of sand layers during strong downwelling events, and that onshore Ekman transport leads to mud layers during subsequent strong upwelling events. Additional hypotheses also are possible. The water depth for mud-sand transitions is commonly near the location where surface gravity waves substantially influence bottom stresses, and wave-current coupling may affect this boundary. In addition to the effects of bottom slope and Ekman transport, other morphologic (e.g., bottom roughness) and dynamic (e.g., wave stress) factors will be evaluated.

The focus on systems with substantial fluvial input will address sediment dispersal by river plumes. Depending on environmental events during the field studies, investigations may be able to contrast oceanic storm deposits and fluvial flood deposits on a continental shelf. Both deposits represent event beds that should contain distinct sedimentological signatures depending on source and transport characteristics (e.g., small-scale internal grading, large-scale lateral trends with respect to the river mouth and bathymetry).

Short-Term Bed Response

This component of the project includes phenomena that affect the time-dependent response of the bed to sediment transport during flow events and between successive events. In addition, research that focuses on characteristics (e.g., thickness, internal geometry) of an event bed will be important. The proposed approach to this component is to formulate and

explicitly test well-tailored models and to make high-quality field and laboratory observations of the time-dependent bed response to sediment transport in both sandy and muddy sediments.

During sediment-transport events, dynamically important parameters (e.g., bed surface roughness and surface grain-size distribution) change. In muddy sediments, horizontal and, especially, vertical changes in yield strength also occur. These changes are likely to influence the thickness of the active bedload layer and its control on the volume of sediment suspended from the bed, as well as the resultant depth of erosion and bed reworking. High-quality data on bed properties and their spatial variation are needed in order to extrapolate over shelf-wide spatial scales.

Consideration of the short-term bed response yields several parameters directly related to the event bed itself. Bed surface roughness (i.e., small-scale morphology) determines the physical structures (at sizes on order of ripple wavelengths) that are observable in box-core radiography. Grain-size distribution of the bed (locally and "upstream") and its evolution during a transport event produce the sediment grading associated with event beds. The magnitude of bottom stresses and the local divergence of sediment flux determine the thickness of the event bed, which constitutes the active layer associated with the transport event.

In the period of time between sediment-transport events, dynamically important properties of the bed are modified by physical and biological processes. For example, bioturbation destroys sediment grading, alters surficial water content, and erases physically produced bedforms. In areas of frequent transport events, fair-weather modifications are unlikely to be completed, and the initial conditions for the next transport event will vary. Incorporating such time-dependent effects into models of successive transport events is a key aspect for this component of the project.

Testing predictions of bed response depends on knowledge of the bed surface morphology and sediment properties over time. Therefore, acoustic (e.g., chirp) or box-core

data are needed regarding event-layer thickness, bed size grading, and physical structures after transport events . Making the link to acoustic and core data is essential for testing models of bed response. In order to make a direct connection between processes and products, every effort should be made to work in an environment for which a number of significant transport events are expected and where sampling the bed shortly after these events is logistically possible.

Post-Depositional Modification of Strata

Sedimentary strata in shallow marine settings are the products not simply of depositional events, but also post-depositional modification prior to final burial. Important physical and biological processes operate on a variety of spatial and temporal scales, and these processes affect dynamically important properties of the bed (see preceding section) as well as the macroscale (mm to dm) internal geometry of the strata. The specific objective of this component of the project is to identify and parameterize those processes that modify strata and have a high probability of affecting the longer-term stratigraphic record. As event beds are buried, thinner beds, produced by shorter-recurrence-interval events, are physically destroyed by longer-recurrence-interval events, which extend deeper into the zone of resuspension and biological mixing (Fig. A2). Event-bed thickness is thus not only a key parameter in determining stratum preservation potential, but lateral gradients in event-bed thickness provide an opportunity to study strata-modifying processes.

On a regional scale, the thickness and frequency of event beds (together with the degree and style of bioturbation) determine the arrangement and extent of the interbedded facies. As a storm current wanes on the inner shelf, a graded event bed is formed. Coarser sand deposited at its base is not likely to be resuspended by the next event and made available for deposition farther seaward (unless bioturbation mixes the bed). A downwelling storm current on the shelf has a seaward component of flow. Transport of sand by such a current is diffusive as well as advective, because sand grains in the transported load are constantly being

interchanged with particles from the bed and the bed is becoming finer in a seaward direction. Thus the grain size of a point on the shelf floor is a consequence of the transport history of the sediment, not just a response to the ambient fluid power. Recent advances in boundary-layer physics have led to analytical and numerical models that can be used to describe sedimentary processes. By constraining these models through field observations, stratal architecture and facies distribution can be predicted.

In the short term, biological modification of strata is a three-dimensional process. Early phases or low intensities of bioturbation produce mottles at scales of order 1 cm. However, vertical and horizontal coherence scales of bioturbation are not known. These scales must be identified to maximize the precision of empirical core descriptions and to identify and test hypotheses about crucial stratum-modifying processes over a larger range of time scales. At the broadest spatial scales considered, side-scan or laser profiling resurveys can identify both physically and biologically produced bottom topography. At intermediate scales, bottom-mounted, side-looking acoustics provide added precision of resurvey information and a tie between towed resurveys and core-based sampling. At the scales of stratum thickness, cores (e.g., box, kasten) provide the essential information. Both orientation and location of cores must be known, to allow this information to be tied to the larger-scale flow measurements and acoustic surveys. Direct fine-scale observations of particle properties (grain size and microfabric), serial and orthogonal X-radiography, as well as diverse radionuclides (e.g., Th-234 to C-14) provide complementary methods for documenting sedimentary structures and making precise chronologic statements regarding the evolution of strata. Not only do these methods provide a means for quantifying stratum modification, but they allow a clear tie to the stratigraphic record, in that phases of the evolution can be quantified and related explicitly to time.

Important time scales associated with biological modification range from tidal to interannual. Changes over tidal scales might appear to be noise, unless they accumulate to produce long-term change. At longer time scales, the magnitude and timing of seasonal

variation in biological processes, driven by temperature or organic-carbon fluxes, are only partially understood. For example, event beds formed during the early winter may stand a higher probability of escaping serious biogenic modification, if the strata are buried by subsequent depositional events. However, beds formed in early winter must survive physical degradation longer than late-winter strata. If events are more physically energetic during El Nino years, which are known to deliver less organic energy to fuel bioturbation, then those event beds may stand a greater chance of preservation.

All of the above implicitly assume a negligible benthic response to the event bed itself. This assumption is probably naive, and both negative (e.g., smothering) and positive (e.g., burial of food resources) responses can be elicited. The type of response to a given event bed is likely to change in both along- and across-shelf directions and, in concert with spatial gradients in bed thickness, provides a wider spectrum with which to address these issues. In this context, manipulative field and laboratory experiments involving biological strata modification will be valuable.

Long-Term Development of Strata

An objective that is important to the overall research program, especially the stratigraphy project, is identification and characterization of the physical and biological processes that lead to the development of strata on time scales up to 10^6 years. Achieving this objective involves extrapolation of knowledge obtained from short-term measurements of modern shelf processes (Fig. A2), and it involves linking observations of modern processes to direct (via coring) and indirect (seismic) stratigraphic measurements. At present, mathematical models provide a means of addressing these questions, and model testing, interpreted in its broadest sense, is a critical issue.

One aspect of model testing is evaluation and calibration for mathematical representations of present shelf processes by comparing model computations with field measurements. This is an ongoing process in which mathematical representations of essential

processes and estimates of model parameters improve slowly as more measurements become available.

A more difficult and probably more important aspect of model testing is evaluation of model extrapolations. Among the critical problems are determining whether the essential processes for strata formation are in fact represented in the model, and determining whether these processes are statistically stationary in time and homogeneous in space over the scales assumed in the simulations. Determining what constitutes a valid model test, and what precisely is being tested, are not trivial questions, especially because detailed information about the forcing does not exist, and because some of the stratigraphic observations (i.e., seismic observations) are indirect. On time scales up to order 10^2 years, reliable statistical information about the physical forcing can be obtained in many locations, and stratigraphic information on comparable time scales can be constrained from radiochemical measurements. Even though corresponding information about biological processes and local bed properties is typically not available, a statistical comparison of model results and stratigraphic measurements is potentially useful on these time scales. As the time scale of interest increases, information about physical forcing becomes less reliable, indirect measurements must be used (at least in part) to characterize the stratigraphy, and model testing is more challenging.

A secondary issue is the implementation of models. Among the questions involved are model approximations and parameterizations over time scales that permit efficient computations, questions related to the accumulation of computational errors over long time periods, and development of efficient numerical schemes.

POTENTIAL STUDY AREAS

Desired characteristics of a field measurement site include: (1) frequent energetic sediment-transporting events; (2) large sediment supply from rivers; (3) distinct, regional-scale transitions in sediment size (i.e., sand-mud transitions, Fig. A3); (4) ability to resample

the site following events; (5) relatively simple morphology; (6) an available oceanographic and geologic data base.

A potential shelf area that satisfies most of these criteria is off northern California (e.g., near the Eel and Klamath Rivers). Previous work has identified mid-to-outer-shelf mud deposits that grade on the shoreward edge into inner-shelf sands. This facies boundary also is associated with a change in bottom slope, from relatively flat-lying muds to steeper sands. The area experiences frequent energetic winter storms, and receives sediment input from rivers. It also has been a site of some initial physical-oceanographic and sedimentological studies.

RESEARCH TASKS AND THEIR JUSTIFICATION

The general plan is to divide the research efforts into two 3-year phases. The first phase will examine the divergence of sediment flux in an inner-to-mid-shelf region and will link this to the resultant formation of lithostratigraphy near a sand-mud transition. Observations will be made of boundary-layer processes and sediment transport, together with observations of the seabed to delineate benthic biological processes. The combined effects on strata will be documented from sedimentological and radiochemical measurements. The links between these many observations will come from boundary-layer and stratigraphy-simulation models. The second phase of research will focus on outer-shelf processes that transfer sediment across the shelf break to the continental slope. In addition, the inner/mid shelf will continue to be monitored for the impact of unusual events (e.g., large storms) and will be sampled by drilling. Only research associated with the first 3-year phase is described here. Based on the results, plans for the second phase will be submitted.

Northern California Study Area

This area meets the criteria for a field site, as described in the previous section. Therefore, the research effort will be focussed here.

Task A1 - The detailed bathymetry and bed roughness in the study area will be characterized. Areas of emphasis will be the mud-sand transition and sites for instrument deployments. This will include swath mapping and side-scan-sonar surveys, as well as observations with stereo-bottom and sediment-profiling cameras.

Task A1 Justification - In order to evaluate processes leading to a divergence of sediment flux, precise information is needed regarding bathymetric gradients, large-scale morphologic features, and small-scale roughness of the shelf surface. These observations also are needed to begin long-term monitoring of temporal changes to the seabed. Bed configurations and their associated bottom roughness are important in determining the interaction between the water column and the erodible bottom. Determining spatial variation of bottom roughness in the vicinity of the mud-sand transition will provide valuable insights into the processes that maintain and control the transition. Detailed mapping of bottom features in the tripod and mooring sites are essential for proper interpretation of fluid dynamical measurements.

Task A2 - The seabed will be sampled with a range of coring devices (box, kasten, vibra, piston) in patterns designed to examine sedimentation: over broad spatial scales, for local process studies, and through periods of temporal fluctuation. Observations within cores will delineate variations in sedimentological character, radiochemical profiles, and benthic biological communities.

Task A2 Justification - Sediment cores are the most important source of data for studying strata formation. Key dynamical properties of the bed, for example, grain size and porosity, are best obtained through analysis of cores. Diverse physical and biological sedimentary structures as well as sequences of stratification are obtained through a comprehensive coring program. Coring provides information over a range of spatial and temporal scales; from microscale vertical changes in grain size to shelf-wide sediment accumulation rates. Key chronologic information, including the vertical position of marker beds, is only obtained through coring. The communities of benthos that cause bioturbation, biological roughness, and other biogenic effects, will be investigated in the cores. Due to the central importance of

coring as a link between active processes and preserved strata, a significant effort will be devoted to this component of the project.

The coring will be undertaken in several stages. During the first year, broad spatial scales will be sampled. Detailed process observations using boundary-layer instrumentation will be performed during the second year and will have localized coring associated with them. Longer piston and vibra coring is scheduled for the third year, in conjunction with detailed seismic profiling. During the second phase of research (after the third year), drilling or deep coring (to 100 m) in conjunction with ODP or another group is expected to provide the best input to unravel the long-term geological record.

Task A3 - A team of people and equipment will be ready to respond rapidly to extreme events (e.g., large storms, river floods, energetic earthquakes) that might occur during the project. The primary objective of the rapid response component will be to document the initial conditions of the seabed following an extreme event. In some instances (e.g., flood events), however, water-column observations also will be made.

Task A3 Justification - Much of the Earth's sedimentary record (including that identified during the comprehensive sampling program; Task A2) consists of strata formed during extreme events. Because several classes of these events occur relatively frequently on the Eel shelf, we have the opportunity to sample directly the stratigraphic signature of extreme events immediately following their formation and to track its modification after the event. After the first year of research, the baseline micromorphology (Task A1) and stratigraphy (Task A2) of the Eel shelf will be well known. Identifying event beds and following their subsequent physical and biological modification will make important contributions to the project and serve as a key link between Tasks A1 and A2 and the bottom-boundary-layer measurements (Task A4). Necessary observations will include coring, and surveying with side-scan sonar and a sediment profiling camera. For a large flood event, CTD/transmission surveys, drifters and aerial overflights also might be appropriate.

Task A4 - An array of near-bottom, water-column measurements of velocity, sediment concentration and particle-size distribution will be obtained at selected locations near the mud-sand transition. The measurement period will span the winter storm season (November to March). Parts of the measurement array within the bottom boundary layer also might serve the extended-duration mooring (Task A5) and the plume study (Task A6). A modelling component will address boundary-layer processes that lead to a divergence of sediment flux near the mud-sand transition.

Task A4 Justification - This task will validate for local conditions one or more models of sediment transport and resulting evolution of the seabed. This information will be used (Task A8) to simulate the evolution of stratigraphy over short (10^1 y) and long (10^3-10^4 y) time scales. Measurements for this purpose require (at a minimum) one near-bottom velocity measurement and one indirect (optical or acoustical) measure of sediment concentration; the necessary information about surface waves can be obtained from NOAA and NOS buoys. Measurements of this type are required at a few cross-shelf positions, in order to determine the response of the bottom for different ratios of sand, silt, and clay. More detailed bottom-boundary-layer measurements (e.g., an array of optical or acoustical sensors or laser-diffraction measurement of particle-size distribution) will constrain further sediment transport models.

An array of instrumented bottom systems (tripods) will be deployed in support of project objectives involving sediment-flux divergence and local resuspension processes modifying bed properties and producing event beds. The emphasis will be on the physical regime separating the inner-shelf sand and the mid-shelf mud. The study will address the generation and maintenance of the sand-mud boundary, and the accumulation of sediment near this boundary. Resolving the divergence of sediment flux is a potentially difficult undertaking, especially if extrapolation to decadal or longer time scales is desired. For this reason, a modelling component also will address processes that produce a divergence near the inner-shelf mud-sand transition, by drawing on recently emerging insights regarding the

physics of bottom boundary layers, measurements obtained in previous studies (e.g., STRESS, CODE and the long-term measurements obtained by NOS and NOAA), in addition to the present study.

Task A5 - A mooring will be deployed for an extended duration near the center of the instrument array and will be maintained for five years. This mooring will provide data regarding current and suspended-sediment fields for a period sufficient to observe extreme events.

Task A5 Justification - Long-term mooring data is critical to the success of the STRATAFORM project for several reasons. The intensive tripod measurements will focus on detailed measurements during one winter season. It is reasonable to expect a transport event with one-year recurrence interval during the tripod deployment, which will provide needed calibration and testing of the stratigraphy-simulation models. However, the likelihood of documenting the physical and stratigraphic response to a major event is significantly higher during a five-year deployment period. The mooring data together with NOAA-buoy wave data will be sufficient to characterize the bottom-boundary-layer hydrodynamics. The mooring is also important for obtaining a long-term record sufficient to establish a current climatology, which (coupled with buoy and hindcast wave climatology), will make it possible to statistically characterize resuspension and event-bed characteristics over even longer time scales (50 years). The Extended-Duration Mooring will be part of the experimental array (Task A4) and will be maintained for periods before, during, and after deployment of that array.

Task A6 - The plume of the Eel River will be studied by direct observations (moored and shipboard measurements of velocity, salinity, temperature and suspended sediment) and remote sensing (satellite photos) in order to determine the response of the plume to forcing by winds, shelf currents and river discharge, in addition to its role in determining the dispersal of suspended sediments.

Task A6 Justification - Observations of the plume during the study period are needed to establish the zero-order physics of its behavior and its influence on sediment dispersal; extrapolation to long time scales will be achieved by combining a simple description of the physics with historical information about river discharge, winds and shelf currents. This task is therefore closely coupled to evaluation of the existing data base.

The Eel River and its plume are dominant features of the sediment dispersal system in the study area. Determining the competing roles of plume dynamics and shelf processes (waves and currents) for controlling the distribution of bottom sediments is a fundamental question that will be addressed as part of this project. An exhaustive study of the fluid dynamics of the river plume is beyond the scope of the present study, but a zero-order description of the dynamics and their influence on sediment dispersal is potentially achievable within the confines of the project. Extrapolations to long time scales that can be achieved by combining knowledge of the dynamics with historical wind, current and discharge records will provide insights that are important in interpreting shelf stratigraphy.

Task A7 - Existing information about the characteristics of the study area will be assembled in order to extend and interpret the results of the field measurement program. This information includes bathymetry, historical records of wind, shelf currents, river discharge and waves, as well as satellite observations of river-plume trajectories. In addition, measurements obtained in other, similar systems (e.g., the CODE region) will be examined in order to supplement the measurements obtained in this project.

Task A7 Justification - An important justification for assembling existing information is that the observational period for this project is short (a few months to at most a few years) relative to development of stratigraphy, which occurs on much longer time scales. Thus extrapolation is required, and use of historical records substantially improves extrapolations. Direct extrapolation to decadal time scales will probably be possible based on the existing data base; extrapolation to longer time scales will require statistical inferences. A second important justification for assembling existing information is that detailed process

measurements obtained in other systems supplement the measurements collected as part of this program. The collection and analysis of existing measurements should be regarded as an intrinsic part of the other tasks.

This work will remove, or significantly reduce the need for collecting additional data on features and processes that are already known for the Eel shelf. In this way, the overall project is not distracted from more focused research. As the existing data is reduced, it will be possible to more precisely define subjects that need additional measurements. This work will be accomplished early in the project so that there will be time and opportunity to carry out these additional efforts. The results will provide each of the researchers with an overall framework for their more detailed measurements and analyses.

Task A8 - Models will be developed to simulate the dynamic character of stratigraphy. The effort will involve models capable of predicting strata produced by known combinations of physical forcing, and also diagnostic models providing insights to interpret existing strata.

Task A8 Justification - Numerical modelling provides an objective method for ordering and understanding observational data based on principles of physics and post-depositional strata modification. It is one of the most structured ways that the data are to be synthesized. The modelling component of the project is to consist of: representations of storm-bed deposition, synthesis of stratal successions down the transport pathway of the Eel shelf, the development of a capability to predict the cross-shelf sediment size, and the generalization of storm-bed formation to facies of the transgressive systems tract on the Eel shelf. The modelling will be constrained by direct observation of boundary-layer behavior. These modelling results are to be further generalized to accommodate a wide range of shelf environments. Long-term large-scale representations will be developed of shelf processes affecting the rate and texture of sediment delivered to slope sedimentary environments (important to the second phase of the project).

Models simulating dynamic stratigraphy provide detailed insights into the processes that control storm-bed formation. Specific conditions encountered and measured during the

field observations will be extrapolated to a wider range of physical and sedimentological conditions, in order to provide predictive capabilities. The modelling effort will apply insights gained from dynamical observations on the Eel shelf to the prediction of stratigraphic architecture, in support of interpretations for the local seismic stratigraphy.

<u>Task A9</u> - The shelf will be studied by high-resolution seismic techniques, with special emphasis on documenting the stratigraphic character of the upper 100 m of the seabed. This profiling will tie together discrete coring stations, and establish the regional stratigraphic setting of the study area.

<u>Task A9 Justification</u> - One approach to exploring the long-term development of stratigraphy (Objective 4) is to evaluate the strata preserved on the Eel shelf. This will be done through detailed 2-D (and eventually 3-D) surveys using a Huntec system. The work is pivotal to linking many aspects of the project and program. Piston and vibra cores will be obtained to extend the sampled sections deeper into the sediment column. The cores will provide ground truth for the seismic records, and the records will allow correlation between coring stations. The high-resolution records are needed to identify areas for detailed 3-D surveys and drilling of the shelf (second phase of project). The records also will be useful for the modelling efforts attempting to predict strata formation and to interpret geological history.